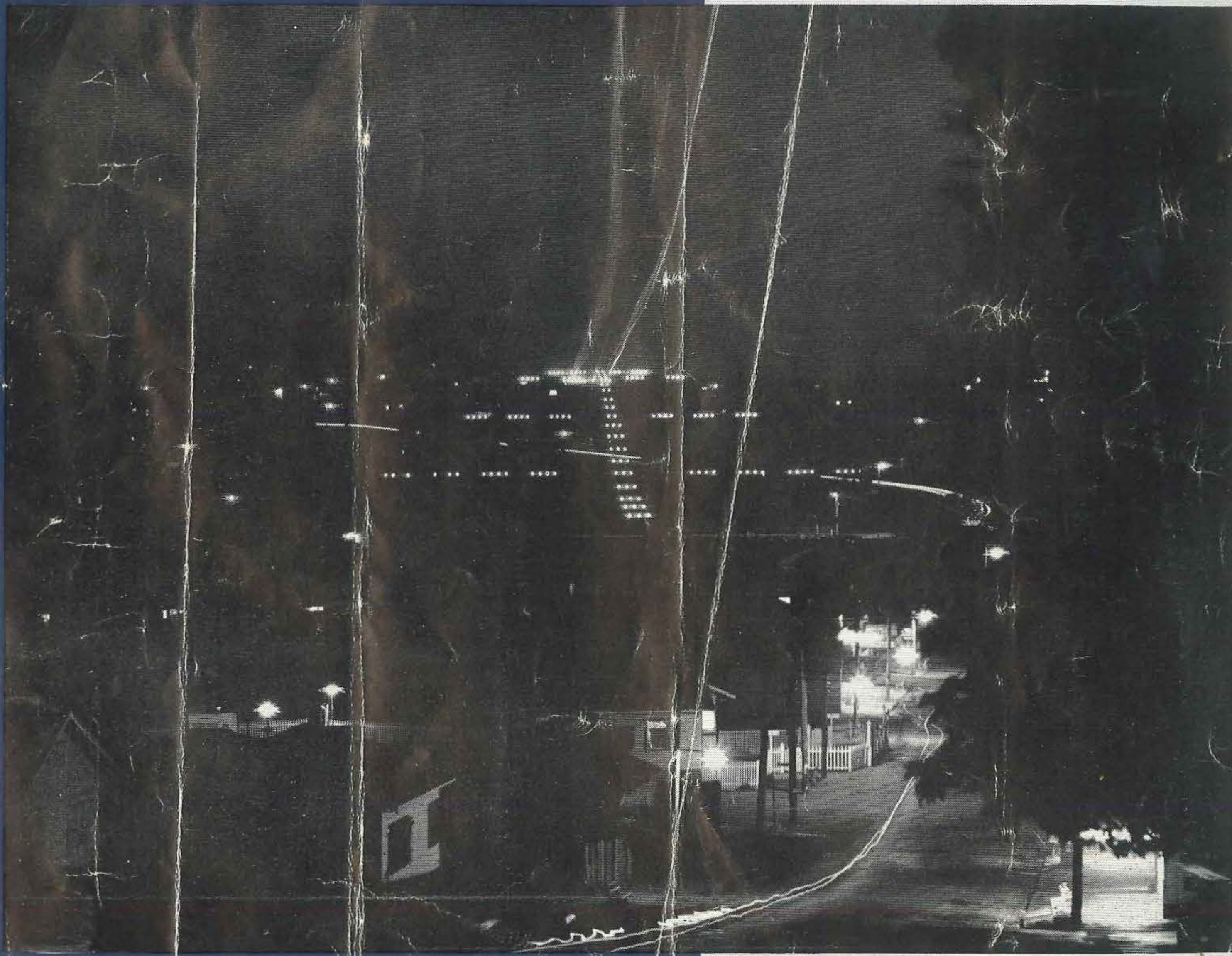
COMMONWEALTH OF AUSTRALIA

Aviation Safety DIGEST



NO. 22, JUNE, 1960

AVIATION SAFETY DIGEST

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Foreword

On examining the material for this issue of the Digest, it seemed appropriate that the article entitled "The Chipmunk Spin" should be given the prominence of first place. The subject has been of considerable concern to the Department and has been under very close scrutiny over a lengthy period. Controversial viewpoints have been held in this matter and the widespread interest that has been aroused fully justifies the attention now given to it in this article.

Throughout aviation history situations have arisen wherein half truths and rumours relating to the characteristics of a particular aircraft type have engendered uneasiness and doubt as to its true performance, often to a stage where safety is seriously compromised. Where this has happened confidence has only been restored after the issue of competent judgment based upon indisputable facts. I believe the point now reached in relation to the Chipmunk spin calls for such action.

My purpose in writing these few words is to express my personal faith in the judgment underlying the confidence expressed in the article. I hope that it will not only be of general interest to instructor and student alike but will achieve the purpose of convincing all concerned that there is no justification for a belief that the Chipmunk is in any way unsuitable or unsafe for both dual and solo training in spinning exercises.

D. G. Anderson.

Director-General of Civil Aviation

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The CHIPMUNK SPIN
THE FACTS

The DH Chipmunk was first introduced to Australia as a training aircraft in 1949 and since then some 80 of these aircraft have been imported for the purpose of flying training. The aircraft came from the R.A.F. with a very good reputation as a basic trainer, and in the first eight years of its use in Australia it proved to be not only an eminently suitable training type but reliable and economical in operation. The first fatal accident involving a Chipmunk in Australia occurred at Goulburn in January, 1957, when the aircraft did not recover from a spin. The type had just been introduced to the particular club and the instructor, who was killed, had just completed his conversion. These facts pointed rather strongly to limited type experience being an important factor in the accident. Nevertheless, Departmental pilots and several club C.F.I's. conducted extensive spinning tests at this time in order to be sure that no hidden spinning vice had suddenly come to the surface to produce this accident. These tests failed to reveal even the slightest suspicion that the Chipmunk had any dangerous spinning tendencies.

At about the same time several reports were made to the Department of particular Chipmunk aircraft behaving in an unexpected manner in the spin. Each of these reports were thoroughly checked and each aircraft was spun several times by experienced pilots. In no case could any unsafe characteristics be reproduced and the aircraft under test never failed to recover normally upon application of the prescribed recovery technique. In the United Kingdom, where experience of the Chipmunk had commenced earlier than in Australia, there had also been some misconceptions regarding the spin behaviour of the aircraft. The De Havilland Aircraft Co. Ltd. conducted evaluation tests and issued several reports with the dual objects of dispelling some of the misconceptions that had arisen and making more widely known the spinning characteristics of the Chipmunk. During the periods of evaluation the airworthiness authorities in the United Kingdom and in Australia laid down spinning limitations both in respect of height for spin initiation and the number of turns before recovery. In Australia the Department regarded these limitations purely as a temporary precaution and they have since been removed.

The first De Havilland report on Chipmunk spinning was issued in 1956 and summarised the experience of pilots who had spun something like 1,000 Chipmunk aircraft, before delivery, in normal and extreme conditions of centre of gravity. The report stressed the need to differentiate between the spin and the spiral and emphasised the importance of using correct entry and recovery procedures. It was pointed out that in most cases the aircraft will first spiral from the stall and as many as three turns may result before the spin proper is entered. This report also showed that in some 20% of the aircraft tested some difficulty in inducing the spin was experienced. Usually this amounted to a reluctance of the aircraft to spin one way whilst being very ready to spin in the opposite direction. Various remedies for this situation were tried, such as altering the flap rigging or aileron droop within tolerances, but the manufacturer has reported that if a careful examination of the mainplane leading edges for any slight flattening or dinting was made and these were removed or dressed out, the difficulties would usually disappear. The report went on to describe the three distinct spinning modes which had been observed —

(a) The steady comfortable spin in which the rotation rate is about 120 degrees per second—nose-down attitude 50-65 degrees, some three turns being completed in each 1,000 feet of height lost.

(b) The less comfortable pitching spin in which the nose regularly rises and falls through an angle of some 15-20 degrees.

(c) The uncomfortable hesitant spin in which the aircraft regularly transits from spin to spiral and then flicks back into the spin.

Finally the report points out that not one of these aircraft had failed to recover from any of these spins or gave cause for any concern on this point to the pilot. In the worst case an aircraft loaded to give an aft centre of gravity condition had taken 2½ turns to recover after eight turns had been completed but, generally, recovery was effected in ½-¾ of a turn with a nose-down angle of some 80 degrees. The first-stage flap setting was used to see if a quicker recovery could be achieved but it had no noticeable effect except in the acceleration to flying speed following recovery. The manufacturer also experimented with the fitting of fuselage strakes* to ascertain if they would reduce recovery time. It was found that although the strakes had no effect on the spin entry, on the spin itself or on the recovery of an aircraft with good recovery characteristics, they did tend to shorten the recovery time slightly on an aircraft normally slow to recover, but it was only a reduction in the order of three-quarters of a turn in the worst case.

After considering these reports and the results of tests conducted in Australia, the Department decided that each and every Chipmunk should be spin-tested at maximum all-up-weight and with the centre-of-gravity fully aft, fully forward and neutral. In the case of each aircraft on the Australian register its behaviour was found to be normal, in that the spin characteristics and responses to controls were safe and within the performance envelope described by the manufacturer. The temporary spin limitations were then removed.

In June, 1959, an experienced and well qualified instructor reported that a student was unable to recover from a spin despite the use of proper recovery techniques and, on taking over, he found a complete lack of stick forces and only recovered by moving the throttle and stick forward and back together. Some 3,000 feet of altitude was lost in this spin. Following this, the instructor immediately climbed to a safe altitude and spun the aircraft in the opposite direction from which recovery was quite normal. Needless to say, this

* These strakes protruded from each side of the rear fuselage forward of the tailplane and in the line of its mean-chord. They were 36 inches long, 3 inches wide and abutted the tailplane leading edge at its root.

experience had a disquieting effect in the club concerned and the Department decided to exhaustively check this aircraft both statically and in flight and, at the same time, instrument it in such a way that its behaviour in the spin could be measured in quantitative terms. This programme has now been completed and its results are presented to you in the belief that not only will they speak for themselves but they will help you to better understand the characteristics of the Chipmunk spin and the basis of the Department's convictions in respect of this aircraft type.

The rigging and movement of all control surfaces, including flaps, were checked on the ground by representatives of the operator, the manufacturer and the Department immediately following the incident and subsequently in greater detail. In all respects these results showed that this aircraft was rigged within the prescribed tolerances and that the control surfaces and actuating mechanisms were completely serviceable. The aircraft was then checked in the air for aerodynamic symmetry before any spinning tests were conducted. At the stall no pronounced wing dropping or yawing tendencies were found. In fact, the aircraft "squashed" without much pitching and sometimes one or the other wing dropped gently. The aircraft's stalling speed with flap up was 45 knots with the usual buffet warning commencing at 49 knots. Observation of wool tufts affixed to the wing indicated that the stall commenced symmetrically at the root trailing edges at 51 knots and that the progression of the stall towards the tips was quite normal. There were no irregularities in the trim of the aircraft and the aileron settings in level flight were port in-line and starboard slightly drooped. Similarly there were no irregularities in the yawing or rolling moments due to sideslip.

The aircraft was then instrumented for the spinning tests. The edges of the perspex panels in the canopy were indexed so that, in the spin, an observer could note and record where the horizon cut the canopy on both sides. From these records the angle of the mean chord of the aircraft above or below the horizon could then be measured with the aircraft in the rigging position. An accelerometer was rigidly mounted on the coaming between the cockpits and the ball of the turn and bank indicator was indexed to facilitate precise measurements. Finally, a stop watch was used to record the time per revolution in the spin.

The spin evaluation programme then started in earnest and almost 100 spins were carried out as well as many experiments in respect of flying control and engine power settings in order to determine the effectiveness of these factors in altering the spin characteristics of the aircraft. Before any spin measurements were taken the circumstances of the incident were simulated to see whether the aircraft's reported behaviour could be easily reproduced using a normal entry technique. Although four spins in both directions, including one of 13½ turns, were carried out, recovery was at all times positive with the stick reaching approximately the neutral position.

A series of spins was then carried out in which the behaviour of the aircraft was measured. As in all Chipmunk aircraft the spin entry was not direct and as many as the first four turns were in the nature of a spiral with the airspeed steady at approximately 50 knots after which the nose lifted, the buffeting of the spiral disappeared and the aircraft settled into the true spin at about 45 knots. It was found that this aircraft had three distinct spinning modes characterised by angles of the mean wing chord below the horizon of 24 degrees, 35 degrees and 43 degrees. Each of these angles were achieved on several occasions and in almost all cases it was apparent that a state of equilibrium had been reached. It is interesting to note that the spinning mode most commonly achieved was the flattest of the three observed (i.e. mean chord 24 degrees below the horizon) and that it was almost the inevitable result of a spin entry using the prescribed standard technique.

The fact that three distinct modes were achieved is by no means a surprising situation since, when an aircraft is stalled, its subsequent motion is governed by the system of forces and moments acting on it. At any particular instance these forces and moments are functions of the lateral and longitudinal attitudes of the aircraft and angular velocities and accelerations about its three axes. Thus the motion of the aircraft is continuously modified unless and until a state is reached in which both the forces and moments are in equilibrium and the motion of the aircraft is then steady or uniform. It is quite common in dynamic systems of this sort to find that there is more than one state of equilibrium.

Other interesting data which these measured spins revealed was that the aircraft rather consistently executed five turns per thousand feet loss in height and turned through 150 degrees on the average each second. In the flattest spin (i.e. mean chord 24 degrees below the horizon) the rate of descent was 4,560 feet per minute, the effective wing tilt* was 9½ degrees, the sideslip

* The angle between the vertical axis of the aircraft and the resultant of the gravity and centrifugal inertia forces.

was towards the axis of the spin at an angle of almost five degrees and the radius of the spin was calculated to be 2½ feet. Comparing these results with the second spinning mode (i.e. mean chord 33 degrees below the horizon) we find that the rate of descent increased to 5,340 feet per minute, the effective wing tilt was one degree less at 8½ degrees, the angle of sideslip was also lower, being just under 4 degrees and the radius of spin calculation showed an increase to something slightly in excess of three feet.

Some experiments were then carried out to discover the effect of various spin entry techniques and some interesting results were obtained. Firstly, the entry speed was varied between 45 and 55 knots and the pre-selected entry speed was approached in a variety of ways. It was found that the most direct entry was obtained from straight and level flight yawing the nose at 50 knots and then applying full back stick and opposite aileron. If a burst of power was used at entry the aircraft would not enter the spin proper until the power was removed. When entry to a right-hand spin was attempted from medium gliding turns or sideslips to the left the usual result was a violent pitching oscillation from which the aircraft would not always enter the true spin. When power of up to 1,600 r.p.m. was applied in the spin it noticeably flattened the angle to about 20 degrees below the horizon, but on closing the throttle the nose dropped again and recovery was quite normal. Full rudder and opposite aileron at 50 knots without full back stick was also tried, but this rarely produced anything but a normal sideslip. The tests did not reveal any simple correlation between entry techniques and the spinning mode but, nevertheless, factors such as an aft centre of gravity position, applications of power, use of full back stick and full rudder from a low nose position at entry all tended to flatten the spin attitude. There is an interaction of so many variable factors in spin initiation that the spin characteristics may appear to be unpredictable, but it is considered that this is a false impression and that the aircraft wil repeat a spinning mode without exception if a consistent entry method can be repeated with sufficient precision.

The effectiveness of ailerons for spin entry and recovery was evaluated and it was found that, in both cases, there was a noticeable result. Opposite aileron increased the yawing moment and is, therefore, a useful pro-spin control. The effect of using aileron in the direction of the spin was to produce a slow change in lateral attitude, the inner-wing dropping. This action is therefore unlikely to accelerate recovery from a normal spin, but it could assist towards recovery if the aircraft's lateral attitude became very flat in a spin.

Attention was then turned to the spin recovery characteristics of the aircraft. At no time during the tests was any difficulty experienced in recovery, and the stick position using the prescribed recovery method was usually at or just aft of the neutral position with resistance to forward stick movement becoming noticeable before the spin stopped. The number of turns for recovery ranged from 1¼ to as many as 3½ turns. It was found in these and many other Chipmunk spin tests that the point at which pressure is felt in the forward travel of the stick varied considerably and is occasionally almost at the fully forward position. Sometimes the pressure was found to be heavy (i.e. as high as 25 lbs.) and sometimes light. In an attempt to explain this phenomenon some radical departures from the standard recovery procedure were used.

When the stick was held back whilst opposite rudder was applied, the rate of rotation decreased and the nose dropped but no further change towards recovery occurred until forward movement of the stick was initiated. Recovery was then normal. The method was then reversed with full rudder in the direction of the spin being held on whilst the stick was moved forward. In this case, the rate of rotation increased with little change in attitude. The stick force was quite heavy at about one-third of forward travel and it remained heavy until recovery was effected after three turns by applying full opposite rudder. Since this combination of controls quickened the rotation, tests using full forward stick were carried a stage further to ascertain if the high centrifugal forces would produce control reversal, but this was not found to occur and the spin characteristics and stick pressures remained constant right through the forward travel of the stick. There was no sign of recovery whilst the rudder was held in the direction of the spin. It seems almost certain from these tests that the stick position and stick force at recovery is dependent upon the co-ordination of controls during recovery. If forward movement of the stick is delayed until the opposite rudder has had time to take effect, recovery will be obtained with a lighter stick force and at a more forward stick position. If rudder and stick are moved together a heavier stick force results and recovery probably occurs at a slightly earlier stick position.

A number of other experiments were undertaken during this test programme but they produced nothing new or of importance. It is quite significant that the results of the evaluation tests conducted by the manufacturer have been confirmed on all major points by the test results in Australia. There are some minor differences of detail, but it must be remembered that the manufacturer's production testing results refer to a very large number of aircraft each of which was spun relatively few times. Although there have been several exhaustive tests on other aircraft in Australia this latest series of tests in Australia was confined to one aircraft which had been reported as exhibiting dangerous spin characteristics and which was spun many times. Some deviations from the manufacturer's test results must be expected in these circumstances, quite apart from the fact that the test conditions were not similar in each case. No doubt slightly different measurements would be obtained if yet another Chipmunk was to be exhaustively tested in the same manner, but there can be no doubt that similar tendencies and similar recovery results would be obtained.

Like any aircraft type the Chipmunk has its own personality and it is extremely important that the pilot should appreciate what to expect from it. Clearly it would be wrong to expect the Chipmunk to behave in the spin like its training predecessor the Tiger Moth, but it is highly probable that this unreasonable expectancy has led to many of the reports of "rogue" Chipmunks. After all, it is a completely different aircraft in so many respects that it would be foolish not to expect it to behave differently.

At this stage some of the Chipmunk spin features will bear repetition:

(a) The aircraft is reluctant to spin properly and it will first of all spiral, but there is little doubt that the entry technique prescribed by the manufacturer is the most reliable method of consistently producing the true spin.

(b) This spiral must be distinguished quite clearly from the spin, but if the pro-spin controls are held on a spin proper will develop.

(c) The spiral can be recognised by a comparatively steep nose-down attitude, an airspeed above the stalling speed and by buffeting.

(d) The number of spiral turns will vary from as little as a quarter of a turn to as many as four turns and the transition to the spin is recognisable by a lifting of the nose, a consequent fall in airspeed, combined with a cessation of buffeting.

(e) An aircraft may spin much more readily and differently one way compared with the other.

(f) Recovery from the spiral using the standard spin recovery method is quick and, in fact, the aircraft will stop spiralling if the controls are released.

(g) The aircraft will not recover from the spin proper by releasing the controls and proper spin recovery action must be taken.

(h) The aircraft may not always adopt the same spinning mode or even a steady spin pattern. Variations in respect of attitude, spin radius, speed of rotation and rate of descent must be expected because of the inevitable small variations in entry technique.

(i) *The proper recovery technique requires full opposite rudder and the stick must be moved progressively forward until the rotation stops* — in some cases full forward stick may be necessary and care must be taken to ensure that the harness adjustment will enable this position to be reached.

(j) The number of turns from recovery initiation to actual recovery can be as many as 3½ turns and full spin recovery control must be maintained until the rotation is stopped — *interruption of this control application will only delay the recovery.*

(k) In all cases application of spin recovery control will tend to lower the nose and speed up the spin rotation — *this is a sure sign that the recovery process has begun and full recovery will eventuate.*

(l) Frequently the resistance encountered as the stick moves forward will be high and this could be confused with the stick having reached the forward limit of travel. A conscious effort is necessary to avoid this confusion.

(m) Despite many reports, there has been no confirmed case of a Chipmunk failing to recover from a spin if the standard recovery technique is applied *and held on* — nor is there any confirmed evidence which would cast doubt on the aircraft's spin recovery ability.

(n) It should be remembered that, if the aircraft spirals through four turns and is allowed to spin three revolutions and full forward stick becomes necessary for recovery, the total loss of height may be as high as 3,000-4,000 feet—provision must be made for this in the selection of height for entry, remembering that it is required that normal flight be resumed not lower than 3,000 feet.

Those of you who have flown the Chipmunk will agree that it is a delightful aircraft to fly. It is not suitable for everybody's needs, but in the training field it represents a big advance on the veteran Tiger Moth. If your pleasure in its flying ability has been completely matched with a confidence in its breeding, a lot of the assurances in this article will have been superfluous. On the other hand, if the article serves to explain some of the phenomena you have already noticed and thereby leads to techniques that are a little more polished, it will not have been wasted. For those of you who have not been happy with the Chipmunk spin it is hoped that this article will cause you to reflect a little on your past experiences and, maybe, more easily to decide whether you have unwittingly blamed the aircraft for behaviour that has been due to an imperfection in your technique or a gap in your knowledge. It is true that the Chipmunk takes a little more knowing than the Tiger Moth, but we hope that this frank discussion of what to expect from it will overcome that problem. The Department has a very real responsibility for ensuring that aircraft types perform safely and in accord with the manufacturers' claims and it would be the first to take action, as it has done in the past, whenever there is doubt. The Department has no hesitation in declaring its complete confidence in the spinning and recovery characteristics of the Chipmunk and fully endorses the techniques prescribed by the manufacturer.

Heed Your Conscience

"Hardly a flight is ever completed that one or more crew members doesn't say audibly or inwardly, 'What a stupid thing that was . . . I'll never do that again!'

"This is good—not the committing of a foolhardy act, but the fact that an admission was made. This confession of guilt means that a conscience is still working and an improvement will be made next time.

"These 'perfect' crimes against safety and common sense are not usually big. For example, a needless thunderstorm penetration, a short-cut check list wherein you forget the flaps, pushing your luck with a known bad engine, or easing down just a few more feet after reaching minima during an approach.

"This little voice of conscience is easy to stifle, and once rebuked begins to unravel like a knitted sweater. When this happens, all limits begin tumbling down and a final picture is usually, at best, a ruined career or, at worst, a pile of rubble marking an end of a crew and their aircraft.

"So, if you still have a conscience, guard it well. It may not always tell you the safest and best method, but it will tell you, in no uncertain terms, when you have violated a basic rule that you have learned to respect. The important thing to remember is: When this witness points its finger, don't turn your back. No one ever consistently offends his conscience without it having its revenge."

(Mats Flyer)

RADIO FAILURE

A DC.4 lost radio reception at night when approximately 20 miles south of Sydney Airport whilst approaching for a landing. The weather at the airport was 6/8ths cloud with a base of 750 feet and the aircraft was carrying fuel for an alternative aerodrome.

Just prior to the loss of radio reception, the aircraft reported at 20 miles from Sydney and was advised by Sydney Control to maintain 5,000 feet, to call Sydney Tower, that the 07 Runway Localiser was in use and that no delay in commencing the approach was expected.

The loss of reception occurred when the change to the Sydney Tower 118.1 mcs frequency was made. When contact could not be established on this frequency, the captain tried 3,023.5 kcs without success and carried out a check of the equipment without finding any reason for the failure to receive. The aircraft's radio transmissions were unaffected and the captain, assuming from side-tone in his headphones* that this was so, passed the aircraft's movements to Sydney Tower.

Approximately three minutes after the report 20 miles from Sydney, Sydney Tower realised that the aircraft was not receiving and anticipated that the aircraft would proceed via the normal approach route to the 07 Runway Localiser and commence descent at the last notified E.T.A. in accordance with the prescribed procedures for radio failure in I.F.R. conditions. Two other aircraft were approaching Sydney Airport at this time and these aircraft were diverted to hold at a position clear of the anticipated approach path and clear of the departure route to the designated alternative aerodrome.

It was established subsequently that from 20 miles out the aircraft proceeded on flight plan track until approximately five miles south of the airport where a turn was made over the oil refinery on the southern side of Botany Bay before being flown to the 07 Localiser holding pattern at 5,000 feet. Shortly after arriving in the Localiser pattern, the aircraft was flown back to a position over Botany Bay where an attempt was made to descend visually through a break in the cloud. However, at 3,000 feet the aircraft could not be kept clear of cloud and it was flown back to the Localiser from where an instrument descent was made to Runway 07. The aircraft landed 24 minutes after E.T.A. and 32 minutes after radio contact had been lost.

* Side-tone is *not* indicative that the transmitter is operating. The transmitter section can be inoperative but if the audio section is serviceable, side-tone will be heard.

DISCUSSION

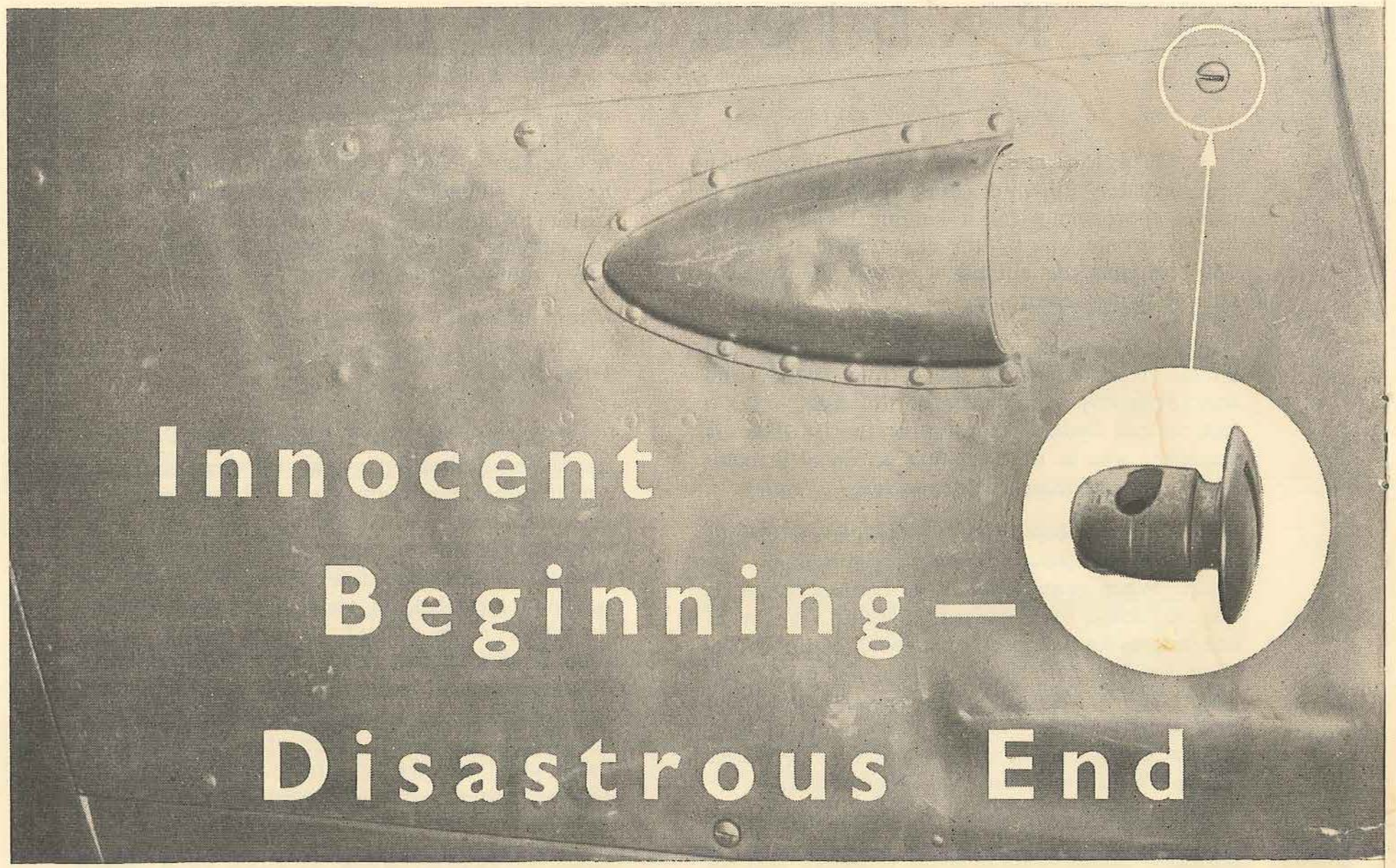
At the time of this incident the relevant AIP instruction authorised a pilot who had lost radio contact to depart from the I.F.R. procedures if he considered that compliance with these procedures was not the safest plan. The captain's reason for making such a departure on this occasion was that, in view of his proximity to the airport at the time of the radio failure, he had some doubts whether A.T.C. would become aware of the failure in sufficient time to provide him with adequate separation from other aircraft if he followed the I.F.R. procedures. The captain's fears were unfounded. In control zones the separation standards and reporting procedures are such that A.T.C. will become aware that an aircraft has lost radio contact before it will endanger or be endangered by other aircraft and only a greater hazard will be induced by not following the I.F.R. procedures.

Following this incident the instructions were amended to authorise departure from the I.F.R. procedures only in an emergency.

LIQUID LIGHTER CAUTION

Extract from Flight Safety Foundation Bulletin, February 11, 1960.

Liquid cigarette lighters with clear plastic fuel containers, as contrasted to the older type with impregnated cotton, react to pressure changes in the same manner as some older type fountain pens. If these liquid lighters are ignited after the fluid has exuded, a dangerous fire can be started.



Innocent Beginning—Disastrous End

Recently, a Dzus fastener compelled an aircraft to make a forced landing, in the course of which it stalled and crashed. The pilot and both passengers lost their lives and the aircraft was destroyed.

At an intermediate stopping place in the course of a scheduled mail flight which serves remote inland areas, the pilot was called upon to exchange his aircraft for one which was to be returned to the company's maintenance facilities for inspection. It was pointed out to him at the time that the aircraft which he was taking over had a defective Dzus fastener locking spring at the front of the engine cowl, also that the maintenance release indicated that there was only one hour and thirty minutes' flying time available before an inspection would be due.

After taking-off from a subsequent stopping place and reaching a height of between 150-200 feet, the engine suffered a loss of power which necessitated an immediate landing. The aircraft was seen to enter a turn to the left which suggests that in view of the predominantly unfavourable nature of the terrain surrounding the aircraft at the time, the pilot may have decided to try to regain the airfield some 2,500 feet away. Very soon after entering this turn the aircraft stalled and crashed out of control.

In reviewing the circumstances it was calculated that the aircraft was incapable of regaining the strip and would have reached the limit of its gliding distance when still at least 1,300 feet from it. It is not known why the pilot failed to realise that the only sound course of action in the circumstances was to land on a relatively clear area which was within comfortable gliding distance ahead. The nature of this area was such that it is unlikely that more than minor injuries to the occupants would result from any accident that could possibly occur from landing on it.

In the subsequent examination of the engine it was found that the button of the defective Dzus fastener had become dislodged and, upon entering the engine via the carburettor air intake, had jammed between an inlet valve and its seat on at least three occasions and had been in the adjacent combustion chamber for a period when the engine was operating. This was the cause of the engine failure although other defects were found in the ignition system.

At the time of the take-off the maintenance release indicated that the aircraft had already flown 33 minutes beyond the 50 hours permissible, however, the correction of errors which had been made during the recording of these times showed that, in fact, only 49 hours and 58 minutes had actually been flown at this time; therefore, the maintenance release expired at the time of the accident which occurred two minutes after take-off. The standard of maintenance, as indicated by the facts, seems to have been far short of that necessary for safe and efficient operation.

Although a reason for the loss of control during the forced landing can never be established with certainty, the accident points very clearly to the importance of maintaining controlled flight under all circumstances. A forced landing such as this demands of the pilot one of the most difficult and complex decisions he can be called upon to make. Success or failure is held in a balance of split seconds and there is no room for indecision or error. The pilot most likely to survive the ordeal is the one who has deeply impressed in his mind the fact that even the faultless decision becomes worthless if an appropriate flying speed is not maintained throughout the approach to land.

OPERATIONAL SEMANTICS

Extract from Flight Safety Foundation Bulletin, February 11, 1960.

Not too long ago a commercial captain, fast and long on a wet runway, decided to groundloop. "Full power on four," he called. He got it. The engineer gave him full power on **all** four. The plane was destroyed in the resultant crash.

Take-off Power:
Maximum power
or . . . remove power?

UPSIDE DOWN AND BACKWARDS

"The pilot of an F-86L in a functional check flight over an overcast became disoriented while attempting to return to the airfield while homing on the V.O.R. He knew his approximate position, but the V.O.R. seemed to give an erroneous indication. After he landed, it was found that ID-250 instrument was installed upside down with the index at the bottom of the instrument. This caused the No. 2 needle to indicate 180° out of phase, and the heading of the aircraft was at the bottom of the instrument, rather than the top. 'Considerable effort,' the reporting officer states, 'was required on the part of the technician to install the instrument in this manner. However, he proved it could be done.' "

—*Interceptor.*

COMMENT

One case, similar to the above, has occurred in Australia. An azimuth indicator with a manual rotatable cur-scale was installed upside down in a public transport aircraft. In this case there was nothing on the instrument to indicate the correct installation position.

This same installation error could conceivably occur on a number of Radio Magnetic Indicators (R.M.I.) at present in use in Australia in conjunction with the A.D.F. system. In many of these instruments there is nothing other than the lubber line index mark to indicate just which side goes to the top.

Although the instrument will continue to function normally even if installed upside down, and the correct bearing can be read if referenced to the lubber line, it was not intended to work this way. Pilots become accustomed to relating all bearings to the top of the instrument, where the lubber line is normally positioned and, by force of habit, will continue to read it this way. If there is any possibility of an instrument being installed wrong way up it is well worth while marking "TOP" in the appropriate position.

DC. 3 Strikes Mountainside

near TRI-CITY AIRPORT
TENNESSEE, U.S.A.

(Summary based on the Report of the Civil Aeronautics Board, U.S.A.)

At approximately 2032 hours on 8th January, 1959, a DC.3 aircraft struck a mountainside during an I.L.S. approach to the Tri-City Airport, Tennessee. All occupants, seven passengers and three crew members, received fatal injuries.

The evidence indicates that the flight departed Nashville, Tennessee, with an inoperative radio compass. Although the clearance was by way of low frequency airway Green 5, it does not appear that the facilities defining this airway were used. Upon arriving in the Tri-City area, the aircraft was east of its intended track and erroneously identified the reporting point from which an I.L.S. approach procedure was to be initiated. During the instrument approach, which was conducted in snow showers, the flight missed the outer marker. The approach was continued under instrument conditions without utilising the V.O.R. facility which would have been of assistance in confirming the flight's position. Without having clearly established his position, the pilot flew 15 miles beyond the outer marker and descended to an altitude too low to clear high terrain in this area.

INVESTIGATION

The aircraft was engaged on a regular flight from Memphis to Tri-City, Tennessee, with scheduled stops at Nashville and Knoxville. The flight was uneventful to Nashville, where the captain was relieved. He later stated at the public hearing that during the approach the first officer was unable to pick up the compass locator at the outer marker on the A.D.F. The aircraft then proceeded uneventfully to Knoxville.

Cumulative en route delays resulted in the flight departing Knoxville at 1946 hours, 27 minutes late. It was given ARTC clearance to the Gray intersection via Green Airway 5 to maintain 5,000 feet and to contact Tri-City approach control when over the Bulls Gap marker beacon. The estimated time en route was 34 minutes at a true airspeed of 145 knots. At 1953 hours the flight advised the company at Knoxville it was estimating Piedmont fan marker at 1956 hours. A few minutes later it reported over Piedmont at 1958 hours, estimating Tri-City at 2023 hours.

At 2010 hours, in accordance with the clearance, Flight 308 reported over Bulls Gap. Tri-City approach control acknowledged the report and further cleared the flight to make an approach to the airport on Runway 27. The latest weather information was also transmitted to the flight: ". . . wind is north, variable, both sides at 10 knots, gusts to 15; altimeter 30.03; Tri-City weather, measured ceiling 900 broken, 1,700 overcast, visibility 3; light snow; fog."

Following the acknowledgment of the approach clearance and weather information, the flight switched to company frequency at Tri-City giving an estimated time of arrival at 2026 hours, reporting the aircraft as being okay for turn-around and asking if it still needed sumps and screens checked.* The chief despatcher answered in the affirmative and logged the time of this contact as 2012 hours. The despatcher was able to identify the transmission as being made by the captain. Twelve minutes later, at 2024 hours, Flight 308 reported to approach control stating it was over Gray intersection† leaving 5,000 feet making an outer marker approach. The controller advised Flight 308 to report leaving the outer marker inbound.

* A standard minor line check for foreign material in the oil sumps and fuel screens accomplished every 50 flying hours.

† The intersection of the south-west leg of Tri-City low frequency radio range and 275-degree radial of the Tri-VOR — three miles south-west of the airport.

At 2032 hours, because there was other traffic in the area, the controller called Flight 308 to ask its position. The captain, who occupied the right seat, at this time asked if the glide slope was operating. The controller advised that it was and asked if Flight 308 was inbound to the outer marker. The captain then stated that his A.D.F. was acting up; that he did not pick up the outer marker either aurally or visually and that they were making a procedure turn. The controller acknowledged and asked the flight's altitude. No further word was received from the flight and it must be presumed that the aircraft crashed immediately after its final transmission.

Another DC.3 had arrived at the Bristol intersection* at 2028 hours and was holding, awaiting clearance to approach to the airport. This pilot, a witness at the public hearing, testified that he was V.F.R. at 5,000 feet, in the holding pattern, however, he could see a cloud layer east of the airport in the I.L.S. approach area which extended from about 3,000 to 7,500 feet. Clear of the clouds, the visibility was more than 15 miles. He said he could see "lights from several cities to the west and north and could see the Tri-City airport." The captain testified that he heard the conversations between Flight 308 and the approach controller at 2024 hours and 2032 hours and was concerned after the latter, when he could not see the aircraft in the Bluff City area. He said he made special note of the time, 2032, because he knew Flight 308 should not still be eastbound eight minutes after passing Gray intersection. However, he did not see any other aircraft in the area. Several minutes later he cancelled his I.F.R. flight plan and proceeded V.F.R. to the airport via the radio range, landing at 2047.

At approximately 2052 hours, after Flight 308 had failed to respond to any radio calls, the controller initiated accident search procedures. The pilot of Flight 383 flew in the I.L.S. approach area on his departure from Tri-City in an attempt to locate Flight 308 which was presumed down. He did not see any sign of the aircraft and reported that the reduced visibility and low ceiling in the area of Holston Lake prevented any further search.

* The intersection of the north-east leg of the Tri-City low frequency radio range and 344-degree radial of the Tri-VOR — nine miles north-east of the airport.

The wreckage was located on January 9th, 1959, at about 1130 hours by a Tennessee Air National Guard aircraft on the north-west side of the Holston mountain range 18.75 n.m. east of the Tri-City airport and 1.25 n.m. north of the I.L.S. localiser path. The terrain in which the aircraft crashed was extremely rugged and heavily wooded. A study of the impact area revealed that the aircraft, while on a course of 235 degrees, first struck several trees which severed the left wing approximately 21 feet from the tip and destroyed a portion of the horizontal stabiliser.

It could be seen from the initial impact marks that the aircraft was in level flight longitudinally with an angle of bank to the right of less than 10 degrees when it struck the trees growing on the 35-degree slope, at an elevation of 3,140 feet near the crest of the mountain.

Some disintegration resulted from its path through the trees. An intense fire ensued in the main wreckage consuming the nose section, cabin sides and belly of the fuselage, the nacelles, and forward part of the wing centre section. Inasmuch as there was no evidence of fire or heat on the trees, underbush, or pieces of wreckage along the crash path, this fire must have occurred after the wreckage stopped.

ANALYSIS

Examination of the wreckage of the aircraft revealed no evidence of any failure or malfunction of either the airframe or the power-plants. There was no indication of fire in flight and all components of the airframe were accounted for in the wreckage. Both engines and propellers were capable of normal operation prior to impact. From this evidence it is clear that no structural or mechanical failure or malfunction occurred which in any way contributed to the cause of this accident.

Examination of the radio equipment indicated that the crew was not utilising all the facilities available to them. The No. 2 navigation receiver was not tuned to a frequency of any facility in the area. It is, therefore, persumed that the No. 2 navigation receiver was not in use. Normally this receiver would be tuned to the TRI V.O.R. (117.7 mcs.) and utilised to determine the back-up radials which define the safe easternmost limit of the procedure turn area.

As near as can be determined the low frequency receiver was tuned between 324 kcs. and 349 kcs. Again, this frequency is unrelated to that of any facility in this area which could be utilised by this receiver. The closest frequency of any local facility to this setting is the Emmett "H" radio beacon, which is 320 kcs. It is extremely doubtful that this receiver would be utilised on Emmett "H," however, as this homer is non-directional. Normally, the low frequency receiver is tuned to the TRI low frequency radio range, 221 kcs., and used as another aid in determining the aircraft position in relation to the radio range legs. It is clear this receiver was not being used on the TRI-LFR because it is exremely improbable that impact forces could move the frequency over 100 kcs.

The A.D.F. was tuned to the radio range frequency of 221 kcs. While en route from Knoxville to Tri-City it would be expected that the radio compass would be used to follow the airway. However, after the aircraft had reached the vicinity of the airport and an approach on the I.L.S. was started, the crew would normally tune the A.D.F. to the non-directional compass locator associated with the middle or outer marker. These frequencies are: 201 kcs. and 239 kcs. respectively.

Another alternative would be to tune the A.D.F. to the Emmett "H" facility for assistance in establishing the safe easternmost limit of the procedure turn area.

Two inferences arise because the radio compass was not tuned to the frequency of a facility which would assist in determining the position along the localiser. The first is that the automatic direction finding feature was not functioning or was not being used. The second is that the radio compass was entirely inoperative and neither the visual presentation nor the audio signals could be received.

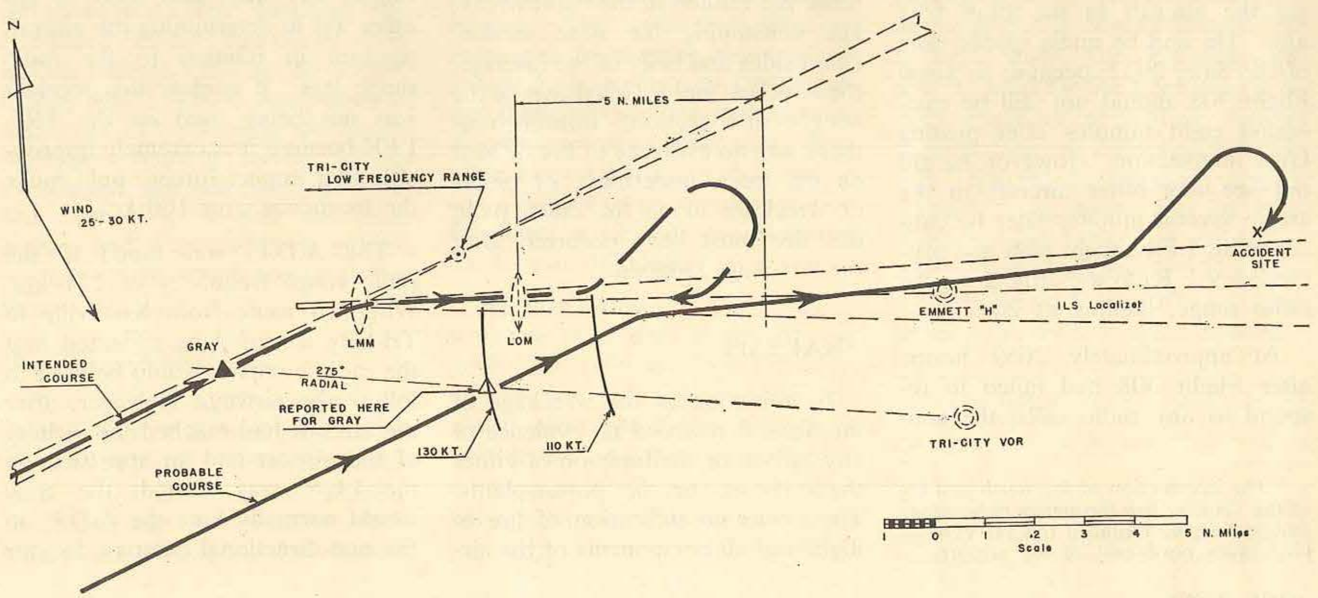
During the last transmission for the flight, the pilot stated that ". . . his A.D.F. was acting up." In addition, the captain who flew the aircraft into Nashville, testified that he was unable to receive either visual or aural signals on the A.D.F. prior to landing at Nashville. The evidence also indicates that he informed the captain who flew the aircraft on its last flight of the malfunction at Nashville, but that no maintenance was performed there or at Knoxville. It is, therefore, reasonable to presume that the A.D.F. was completely inoperative and further that the crew was aware of the situation prior to take-off from Nashville.

It should be noted here that there is a remote possibility that a sight-seer at the crash site could have altered the setting found on the No. 2 navigation receiver frequency selector; it is also possible that the frequency selector was moved as a result of heavy inertia forces. If this were true and the receiver was being used on the TRI V.O.R., the pilot should have been acutely aware of his position. As for the A.D.F., because of the fire markings on the dial and exposed gears, investigators determined that the frequency setting had not been altered. It is clear that this receiver was tuned to 221 kcs.

Flight 308 reported as being over Gray intersection at 2024 hours. About 2032 hours, the conversation with the tower took place. Before completion of that conversation the aircraft crashed. This would place the accident, as near as can be determined, at 2032 hours. A study was made to determine the airspeed which would have been required for the aircraft to traverse the distance from Gray to the crash site in eight minutes. These calculations revealed that the aircraft would need to have had an airspeed of 180 knots or a groundspeed of 191 knots to travel from Gray intersection to the accident site in eight minutes. Obviously, this speed is much too high for a DC.3, especially while manoeuvring prior to an I.L.S. approach From the calculations it is evident that the aircraft could not have been over Gray at 2024 hours, as it reported.

Two airspeeds, 130 knots and 110 knots, were selected as representative manoeuvring speeds at which an I.L.S. procedure would be flown. Substituting each of these speeds in the computations, and starting at the crash site working back towards Gray, it was possible to determine two lines of position along one of which the aircraft had to be located eight minutes before the crash. (These are displayed graphically in the sketch.) It was immediately discerned that the 110 knot line of position could not, in all probability, be correct because it was impossible to correlate the en route reporting times to it. However, the 130 knot line of position appears to be consistent with all the known facts.

From the position report over Piedmont at 1958 hours and the report over Bulls Gap, which is 30.5 miles from Piedmont, at 2010 hours, it can be seen that the groundspeed of the aircraft was 152 knots. The next position report was over Gray, 32 miles from Bulls Gap. At a groundspeed of 152 knots, this segment should have taken 12.5 minutes. However, the flight did not report over Gray until 2024 hours, 14 minutes after passing Bulls Gap. At this same groundspeed the aircraft would have travelled 35.5 miles, or at least 3.5 miles closer to the accident site than Gray. In other words, when the flight reported over Gray it was actually 3.5 miles or 1.5 minutes beyond Gray. By plotting this distance (35.5 miles from Bulls Gap) on a chart, it was found to cross the 275-degree radial of the Tri-City omni at the same approximate point as the line of position calculated for a manoeuvring speed of 130 knots. Again referring to the sketch, it can be seen that a course from Bulls Gap to this point would pass approximately two miles east of Gray.



As stated before, the Board believes that the A.D.F. was inoperative as reported by the captain who flew the aircraft to Nashville. It further believes that the flight from Knoxville to Tri-City was made in instrument weather conditions without using the low frequency radio aids which define Green Airway 5. There was evidence at the public hearing that, in some instances, pilots were using the intersection of the 65-degree radial of the Knoxville V.O.R. and the 275-degree radial of the Tri-City V.O.R. as Gray intersection. The intersection of these radials is very indefinite because of the distance from Knoxville and it is possible to receive an indication which could place it several miles east of Gray.

On the basis of all this evidence the Board believes that the crew flew from Knoxville to Tri-City utilising the Knoxville V.O.R., and attempted to locate Gray without the aid of the low frequency radio. The winds aloft were reported to be from the north-north-west and would tend to drift the aircraft east of its course. It is clear that all of these factors combined to cause the aircraft to arrive at the position which was reported as Gray intersection.

Had the aircraft been at Gray the correct procedure would have been to continue on the same heading as the low frequency range leg (65 degrees) to intersect the localiser at the middle marker and then to turn to a 90-degree heading to track outbound past the outer marker. It is probable that the crew, thinking they were in the vicinity of Gray, followed the normal procedure for intercepting the localiser. From the position which it has been shown the aircraft was over when it reported Gray, a course of 65 degrees to the localiser would pass south and east of the outer marker. Thereafter, without receiving the outer marker and without the use of the low frequency receivers or the No. 2 navigation receiver, the flight would be unable to determine its position along the localiser.

From the calculations which were mentioned above, the time interval from the Gray report to the beginning of the procedure turn was found to be 5 minutes and 45 seconds. Normally, a procedure turn would have been started approximately 3 minutes and 30 seconds after passing Gray. Even if the flight had been over Gray, as it reported, to continue 2 minutes and 15 seconds beyond the normal flying time to the outer marker would place the procedure turn well beyond the authorised 5 mile limit and probably beyond the 5 mile buffer area which is provided as a safety zone east of the procedure turn area. Had procedure turn been started 3 minutes and 30 seconds after this report, as is normal, it is probable the accident would have been avoided.

It is assumed that the flight did receive the localiser indications. However, it did not receive an indication of the outer marker. The transmission from the flight asking if the glide slope was operating indicates that this instrument was not operating properly or that they could not rationalise the indication from it with their supposed geographic location. If the localiser had been intercepted to the west of the outer marker, the glide slope indicator would have been at a full fly-down deflection because the aircraft would have been above the glide slope. It would have changed from full fly-down to full-fly-up as the aircraft proceeded eastward on the localiser past the outer marker.

It is apparent that the flight finally realised it had missed the outer marker and must have realised they were east of it, because they started their turn. Both crew members were familiar with the Tri-City Airport and facilities and both must have been well aware of the terrain variations in the area. When they realised they were east of the outer marker an unknown distance, the first and only proper action was to execute a missed approach procedure, climbing to 5,500 feet on the west course of the localiser.

It is possible that either the glide slope indicator or the outer marker beacon did not function properly. It may be that the crew concluded they were inoperative. In this event they were wrong in continuing the approach.

Actually, the aircraft intercepted the localiser east of the outer marker. At this point, the glide slope indicator would have been at a full fly-up deflection because the glide slope was above the aircraft. It may be that the crew was confused when, thinking they were west of the outer marker, they received an indication opposite to that expected. It is also possible that high terrain intervening between the transmitter and the aircraft may have blocked the signal (which is

V.H.F. and line-of-sight) from being received by the aircraft, causing a flag to appear in the deviation indicator of the aircraft. In either case, the Board believes the crew had a clear duty to discontinue the procedure immediately and execute the approved missed approach.

PROBABLE CAUSE

The Board determines the probable cause of this accident was the failure of the pilot to identify Gray intersection properly and his decision to continue an I.L.S. approach contrary to company and regulatory procedures.

COMMENT

It is probably true that very few pilots of experience can say with honesty that they have never assumed the aircraft to be in a position which subsequent events proved to be false. How often has the enthusiastic map-reading navigator conjured up non-existent physical features or distorted those in view to make them fit the point on the map where his flight plan says the aircraft "must" be. This report on the DC.3 accident in the United States illustrates clearly, and only too tragically, that similar traps lie-in-wait for the I.F.R. pilot employing radio navigational aids. With disturbing frequency the incident reporting system throws up instances of pilots, even very experienced ones, being deluded as to the position of their aircraft because of false assumptions, lack of care in handling navigational equipment or neglect of the essential double check in establishing a position by reference to a radio aid when operating within the airways system. The traffic separation and terrain clearance standards are based on the known inaccuracies of ground and airborne equipment, but they cannot cope with a pilot who misuses the equipment and accepts and reports a position based on inadequate information or false assumptions.

Undoubtedly the most critical point in respect of both terrain clearance and traffic separation is one at which an aircraft enters the descent area associated with the destination airport. All of these points on the major trunk routes have double check facilities for fully equipped aircraft and, in the majority of cases, a position can be positively established by passage over a radio aid. The dangers of an inaccurate position report in these areas are too obvious to need elaboration. **Be sure you know where you are before you let down — identify positively the aids being used — cross check one aid against the other and satisfy yourself as to their serviceability.** When an over-the-top fix is required check both aurally and visually that an over-the-top passage is achieved. Last, but by no means least, **don't be too ready to accept that an aid is unserviceable simply because it gives indications different to those you are anticipating.**

Chipmunk Crashes During Precautionary Run

A Chipmunk was authorised to fly from Hobart to Kimberley, Tasmania, stopping to refuel at Western Junction. The pilot was instructed to land at Kimberley on a field prepared for the purpose and not to indulge in any local flying there. He was also told that if a landing on this field appeared to be inadvisable for any reason, the aircraft was to proceed to Devonport.

The aircraft arrived at Kimberley where the pilot identified and landed on what he thought was the prepared field. The correct field was, in fact, situated about a mile away. Since operations from the field on which he had landed would be restricted to certain winds, the pilot flew over to inspect the other field and carried out a precautionary run to inspect the surface of the field with no intention of landing because it was decided to be too small. When at a height of 20 feet at the end of the run, in which full flap was used, the throttle was opened and the aircraft responded with a slow rate of climb. This proved to be insufficient to provide safe clearance over approaching trees, so a turn was made to avoid them. The power absorbed by the forces of the turn with full flap was such that height could not be maintained even with full power and the aircraft commenced to descend.

The pilot elected to put the aircraft on to the ground and in doing so both wings, the fuselage, the propeller and undercarriage were extensively damaged, although neither he nor the passenger was injured. In this flight the pilot not only disobeyed the terms of his authorisation but employed incorrect technique by using full flap for the precautionary run.

Weather + Inexperience = Downfall

ONTARIO AND NEW BRUNSWICK, CANADA

(Summary based on the Report of the Department of Transport, Canada)

(All times are Canadian Eastern Standard)

A Piper PA.22 departed from a field near Big Lake, Manitoulin Island, Ontario, at 1130 hours on 21st May, 1959. About ten minutes later it encountered a heavy rain squall and, while attempting to land, crashed into trees. The pilot, the sole occupant, received minor injuries and the aircraft was destroyed.

INVESTIGATION

The aircraft was on a flight from St. Catherines to Prince Albert, Saskatchewan. Departure from St. Catherines was made at 0630 hours and a landing made at Hamilton to refuel. The pilot did not check the en route weather and the departure was made at 0800 hours.

After passing over Wiarton, Ontario, the pilot proceeded across the straits of Manitoulin Island. There were fog patches over the water and, after crossing the shoreline, he flew into rain and fog and lost visual contact with the ground. A call was made from the aircraft to Wiarton Radio at 1025 hours and the pilot reported that he was at 9,000 feet, lost, and in fog, but holding on the Wiarton Omni Range. Air Traffic Control were unable to give descent clearance at that time because of traffic. At 1036 hours, clearance was given to descend to 3,000 feet a.s.l. The aircraft was running low on fuel at this time so the pilot decided to descend through cloud. He made visual contact over Big Lake, Manitoulin Island, with a ceiling between 300 and 400 feet. Witnesses described the weather as foggy with poor visibility. A safe landing was made in a field at about 1100 hours. He reported his position by telephone to Gore Bay Radio.

At about 1130 hours the pilot considered that the weather had improved and took-off to continue his flight to Gore Bay Airport. About ten minutes after take-off the aircraft was flown into a heavy rain squall with conditions of near zero visibility. The aircraft struck trees and crashed while attempting a turn for a landing on a road.

The pilot did not hold an Instrument Rating and had little instrument flying experience.

The weather in the Gore Bay area during the period of the flight was forecast to be ceiling 3,000 feet broken, 10,000 feet overcast, visibility two miles in fog, occasionally ceilings 500 feet overcast, visibility one-half mile in fog during the period 1500 to 1800 hours. An aftercast indicated that conditions along the route were frequently below Visual Flight Rules minimum. The visibility was one to two miles for the most part and occasionally near zero in fog over water and higher ground.

CONCLUSION

The pilot continued a V.F.R. flight into unfavourable weather conditions and flew into trees in conditions of near zero visibility. Contributing factors were considered to be inadequate flight preparation since weather information was not obtained prior to take-off, and the pilot's lack of instrument flying experience.

At 1215 hours on the 22nd May, 1959, a Cessna 120 departed Moncton for a flight to Fredericton, New Brunswick. About 30 minutes after departure the pilot encountered low cloud over hilly country west of Sussex. While attempting an emergency landing on the highway, the tail of the aircraft struck a telephone pole and the aircraft crashed. The pilot, the sole occupant, was uninjured but the aircraft was substantially damaged.

INVESTIGATION

The pilot checked the weather during the morning, at which time the weather was unfavourable; however, he did not take-off until some time later and did not re-check the weather. At the time of his departure from Moncton, the Fredericton weather had been reported as a balloon ceiling 400 feet broken, 800 feet overcast, visibility five miles in fog and haze. An eyewitness at the scene of the accident described the weather as very foggy with little, if any, wind.

After encountering lowering weather in the hills, the pilot continued his flight until he considered he could not reverse course due to the narrow valley so he decided on a landing on the highway.

The pilot had accumulated a total of 142 hours 15 minutes' flying experience with 99 hours on Cessna 120 aircraft; 46 hours had been flown on that type within the 90 days prior to the accident.

CONCLUSION

The pilot continued a V.F.R. flight into deteriorating weather and substantially damaged his aircraft while attempting an emergency landing. In addition he did not adequately prepare for his flight by obtaining up-to-date weather information before his departure.

Maintenance Aberrations

From time to time we have published short articles about situations with high accident potential arising from apparently minor deviations from standard practices in aircraft maintenance. For this issue, we have chosen a number of articles telling of similar occurrences, each of which could have led to an accident under less fortuitous circumstances.

AIRFRAMES

In the course of a pre-take-off check, the pilot of a DC.3 noticed an unusual stiffness in the aileron controls. Investigation revealed the inboard aileron push-pull rod was disconnected at the bell-crank end. The retaining bolt was found lying in the wing, but the nut for this bolt could not be located.

Further investigation established that the aircraft had been operating with the push-pull rod disconnected for some time. It was eventually concluded that the bolt had been inserted into the bell-crank end from the bottom upwards during trial rigging adjustments at the time the aileron was installed and rigged. When the rigging was completed, the engineers concerned apparently overlooked the fact that this bolt had not been correctly inserted and the nut not pinned.

At this time the aircraft had flown 80 hours since complete overhaul and for this situation to exist, it is obvious that not only did those responsible for installing the aileron overlook an obvious error, but final inspection, dual inspection of controls, and a subsequent 60-hourly inspection for renewal of the maintenance release all failed to detect that the bolt had not been correctly installed and locked. Standard practices call for bolts to be inserted with the head uppermost unless there is a specific reason for it being reversed. Had the bolt been installed in this manner, it is unlikely that it would have fallen out even if the nut had not been fitted. In addition, the absence of the nut would have been obvious during the various inspections.

The circumstances indicate the push-pull rod was adrift at the time the 60-hourly inspection was performed. We can but wonder how thorough was this inspection and how much was taken for granted because "the ship was just out of overhaul." *Detection of this type of defect is one of the primary purposes of routine maintenance inspections.*

* * *

Now, just to prove there are exceptions to every rule, there is the following case where the bolt had to be the other way up.

The captain of a Lockheed 1049 noticed on pre-take-off check that full left-hand rudder travel could not be obtained. Examination showed that with the pedals in the shortest leg-length position the right-hand pedal fouled the floor structure. It was subsequently found that the bolt which secures the ratchet to the quadrant had been incorrectly fitted. This particular bolt is one which requires the *nut* to be on top, as the nut acts as a limiting stop at the shortest pedal setting. With the bolt head at the top, the pedal adjustment pawl had "jumped the stop," resulting in restricted rudder movement and bending of the brake operating link assembly.

This particular bolt should have been an easy one to sort out, as in all three other rudder pedals the bolts were correctly fitted.

* * *

ENGINES

On arrival at an outstation, away from the normal maintenance base, one engine of a DC.3 failed to stop when the mixture control was pulled into idle-cut-off. When the lever was moved fully forward, into the emergency position, the engine stopped in the normal way. Examination revealed the mixture control arm was operating in a reversed sense due to incorrect assembly.

It is not difficult to imagine the dismay in the cockpit had circumstances demanded the use of emergency rich on this engine. It is also not difficult to imagine the problem of fighting the fire which could have occurred at start-up with the mixture control supposedly in idle-cut-off.

* * *

A Lockheed 1049 engine could not be shut down. On investigation a hammer was found to be lodged between the fuel control unit operating rod near the bell-crank and the side of a compressor casing. Further checks showed it had been left inside the engine cowling five days previously. This could easily have cost far more than the loss of a good hammer.

* * *

A DC.3 suffered backfiring and loss of r.p.m. on No. 1 engine in flight. Inspection showed No. 1 cylinder induction pipe loose and adrift at the upper end. The induction pipe had been changed five days before. There was no explanation for this defect, other than that the nut had not been properly tightened.

* * *

ELECTRICS

The pilot reported no charge from the right-hand generator on a DC.3. Investigation showed that the generator negative terminal in the terminal box had overheated, causing the insulation to burn back along the lead. This resulted in a short circuit to the field lead which burnt out and, at the same time, the negative lead burned out of its terminal lug.

The primary reason for this defect was the omission of a spring washer under the terminal, resulting in a high resistance connection.

A spring washer is essential for electrical connections where terminal lugs are joined to compressible materials such as aluminium or copper, owing to their tendency to creep during service. With flat or shakeproof washers the connection will loosen off, but the spring washer will maintain pressure between the lug and its mating surface.

Modern aircraft manufacturers, in general, stipulate that spring washers will be fitted to electrical connections, especially where there is a high current flow. One leading manufacturer originally listed shakeproof washers as an alternative, but after experiencing a number of loose connections in service, now insists that only spring washers are used. Merely preventing the nut from unscrewing is not sufficient — the whole purpose of the exercise is to maintain a low resistance connection by ensuring that the mating surfaces are retained firmly together.

★ ★ ★

A Chipmunk pilot was somewhat startled to see a flash of flame, sparks and smoke issue from beneath the instrument panel in-flight. To his relief, it stopped after about six seconds. Inspection revealed a short circuit in the ammeter lead behind the instrument panel. The nylex sheathing had been inadvertently pulled away from the connector, allowing the insulation to chafe through and the lead to earth to the instrument panel.

The particular installation, where the ammeter was installed in the main instrument panel, was prone to this type of trouble, due to frequent raising and lowering of the panel and inadequate inspection access. The operator has now moved the ammeter to a small fixed panel at the side of the cockpit.

★ ★ ★

A short circuit occurred in a voltage regulator box during aerobatics. It was later found that a 1/16" split pin had entered the box via cooling holes in the bottom during inverted flight. This pin had lodged across between an active terminal and the box.

The most effective means of preventing this sort of thing is to ensure there are no "foreign objects," even split pins, lying in the aircraft: because human beings are fallible, however, the actions of this operator in fixing some gauze wire over the cooling holes, even those on the bottom of the box, is a wise precaution.

★ ★ ★

Incorrect screw length is one of the most common reasons for electrical short circuits. In one recent case, smoke was observed in a V.H.F. control box wiring. Subsequent investigation showed a screw holding the side panel on the control unit was shorting to the 28 volt dimmer switch line. It was found that if a screw longer than 1/4" was used in this position a short circuit was inevitable. The control boxes on all similar aircraft were immediately modified to move the nut retaining bracket 3/4" towards the back of the unit, thus permitting the use of a longer screw.

Though the designer normally guards against this sort of thing, he can sometimes overlook such a simple but important point. If it should happen that you notice that a short screw is necessary to prevent a short circuit, don't just use a short screw and let it go at that. A simple modification may prevent a short circuit if the next fellow isn't quite so observant.

CAUTION IN CUPS

Certain plastic-lined paper cups are dangerous. Several have been known to burst into flames when a lighted cigarette came in contact with them. One source of information claims there are plastic-lined cups in use which the plastic coating burns more readily than the paper itself. The practice of using paper cups as ash trays is dangerous, particularly when the cups are of the type mentioned. Use only the proper ash receivers.

Business Pilots Safety Bulletin.

COMMENT

Plastic-lined cups are not commonly used in Australian aircraft and we have no record of fire hazards arising from this particular source. This does not detract from the lesson. There are many tempting alternatives to the proper ash receivers — don't be tempted — it could be dangerous.

MURPHY WAS HERE!

(Extract from Business Pilots Safety Bulletin 60-202)

"A DC.3 was being test hopped after a periodic inspection. During the inspection the chains in the pilot's and co-pilot's control wheel had been checked, and in reassembling the pilot's wheel the aileron chain assembly had been reversed. All the succeeding flight control checks were then made by using co-pilot's wheel, and movement of the control surfaces was correct with relation to the control wheel. No one observed the pilot's wheel turning in the wrong direction when the checks were accomplished. Even when the two pilots made their checks of the flight controls, the same thing happened: the co-pilot handled the wheel and the pilot looked out.

"Anyway, after the aircraft got up into a 60° bank on take-off the co-pilot yanked off the left throttle and the wings just about attained level attitude when they hit the ground. Maintenance error and supervisory error, both entered into this one. But there was a bit of cockpit trouble, too!"

"We got this from one of the military aviation publications, but it could happen (and has!) to civilian aircraft."

COMMENT

In Australia, exactly the same error did occur on a civil aircraft during re-assembly after complete overhaul. However, in this instance, it was discovered during the second stage of a duplicate inspection of flying controls.

DIFFERENT ERROR — SAME RESULT

A DC.3 crashed on the aerodrome at Archerfield, Queensland, during take-off on a test flight following overhaul for the renewal of its Certificate of Airworthiness.

The take-off run was commenced and soon after becoming airborne the aircraft commenced to bank to the right. Within a few seconds the aircraft was banked so steeply that the right wing tip touched the ground. The take-off was abandoned and the aircraft landed heavily with the resultant collapse of the port undercarriage.

The cause of the accident was a loss of control during take-off. The operation of the aileron control surfaces were reversed because of incorrect assembly of the aileron control cable. The L.A.M.E. in his inspection had failed to detect that the cables had been incorrectly assembled, and the pilot had not ensured that the flying controls were functioning correctly before commencing the take-off on the test flight.

This particular accident occurred some years ago, before the requirement for independent duplicate inspections of control systems was mandatory. We believe a duplicate inspection by independent engineers would have detected the incorrect assembly and averted the accident.

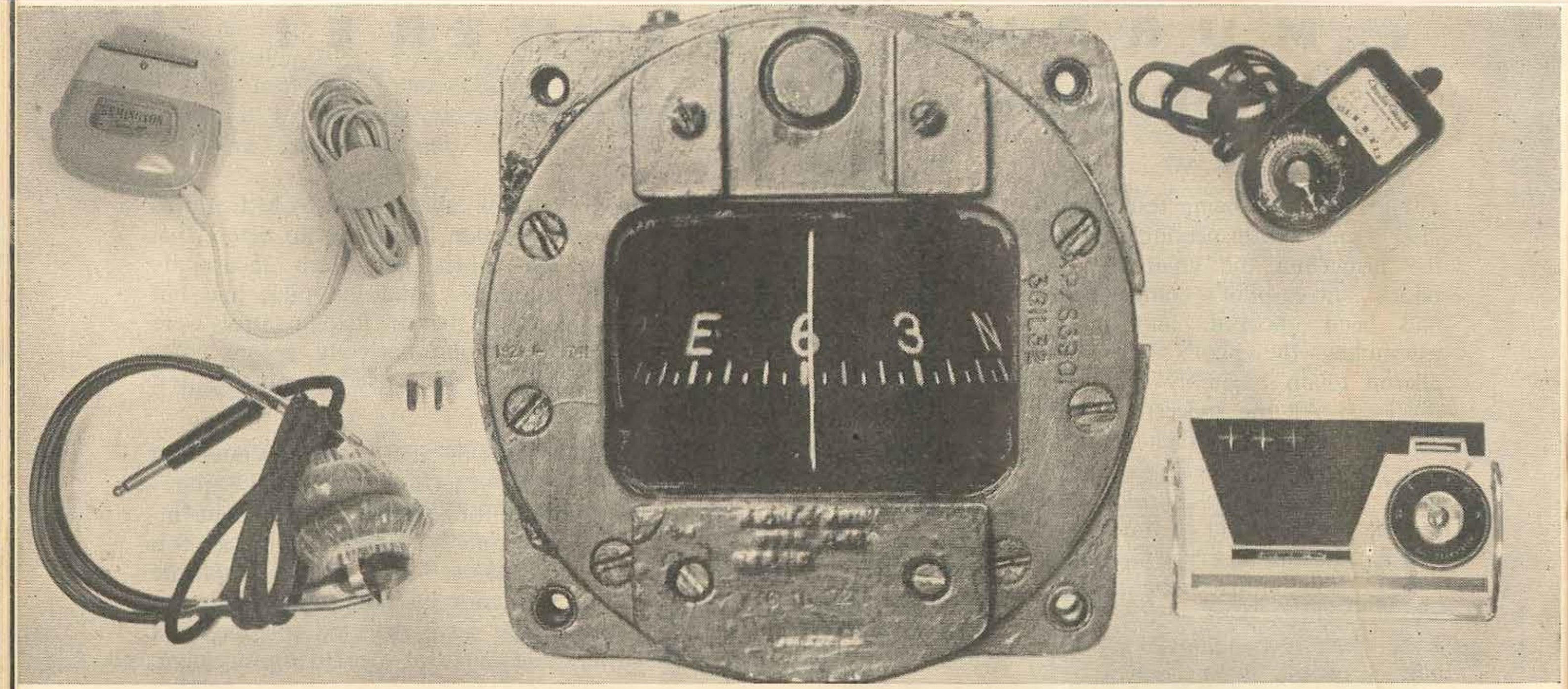
"TAKE A LEAD"

Investigations into a recent fatal accident involving an Auster aircraft revealed a fault in the ignition switch installation which, although not contributory to the accident, revealed an intolerably hazardous situation.

The switch involved was a standard Air Ministry type ignition switch in which the port and starboard ignition leads pass respectively through two holes in the switch bakelite housing and are subsequently held down by two screws. As these two holes are blind it is difficult to ascertain with certainty that the leads are positively secured by the screws and if an ignition switch lead happened to be shorter than normal the risk of the lead remaining unsecured is considerably increased. If a lead should become disconnected from its hold-down screw an open circuit condition will exist which means that the magneto cannot be switched off. Should either lead become completely adrift from the switch and make an earth contact the magneto will be automatically switched off.

The likely consequences of the above situation should be immediately apparent. In the one case it could lead to serious injury to ground personnel if a lead were to become disconnected. In the other case it could lead to a magneto failure and possible engine failure.

This is just another of those seemingly innocent situations which require proper maintenance and careful workmanship if injury or death is to be avoided.



Hazardous Influence

The placing of odd personal objects on ledges in an aircraft cockpit has long been recognised as a potential hazard to flying safety because of the possibility of these objects getting into places where they can interfere with vital controls. Precision cameras, with their attendant light meters, and other personal items such as portable radios are now added to the list of personal objects that can cause hazards which may not be recognised by some of our readers. These hazards can be easily avoided — provided that the crew are aware of the way in which they are created.

AIRCRAFT MAGNETIC COMPASSES

Light meters, in common with almost all electric meters, and radio speakers contain small but powerful permanent magnets which, when placed near to the magnetic compass, will cause serious deviations. The position of many of the places commonly used for the convenient stowing of personal items in modern light aircraft is such that the stowage of items which have a magnetic field can cause very significant compass deviations.

Tests conducted on a popular type of light aircraft, using two different types of light meters, provided the following figures when the meters were moved laterally across the ledge above the instrument panel and towards the compass which is centrally mounted above this ledge.

Rotation of No. 1 meter, when at the closest point recorded below, produced a compass needle movement of 310 degrees. The same rotation of No. 2 meter caused the needle to swing through the full 360 degrees. At all distances recorded, rotation of the meter through 180 degrees caused a reversal of sense in the compass deviation.

Meter No. 1

Deviation in Degrees	Distance in Inches
—	16
5	12.5
10	9.5
20	7.5
30	6.5
40	5.5
50	5.25
60	4.25
70	4
80	3.25
90	2.00

Meter No. 2

Deviation in Degrees	Distance in Inches
5	20
10	16
20	11
30	9
40	7.75
50	6.5
60	5.5
70	4.5
80	3.25

When stowed in the "glove box" which, in this particular aircraft is situated 15 inches from the compass at its closest point, No. 2 meter could be positioned so that it produced a six degree deviation. No. 1 meter in the same position had no effect. Neither meter produced a deviation when placed on the front seats, at the control column, or in the pockets of the pilot's clothing whilst he was seated normally.

These figures relate to only two of the numerous brands of light meters available. Some, with steel cases, may have a lesser effect, but others, with large magnet systems, will possibly have an even greater effect on the compass. No doubt the results will also vary with individual aircraft types.

A transistor radio, in similar positions, produced deviations ranging from 10 degrees at 12 inches, to 70 degrees at 4½ inches from the compass. Rotating the radio receiver at a distance of 4½ inches from the compass produced a deflection of the needle through 330 degrees. These effects will occur irrespective of whether the set is *switched on or off*. Deviations were also obtained by placing the normal radio headphones in various positions adjacent to the compass.

Provision of suitable stowage pockets, well clear of the compass and the aircraft radio apparatus, will eliminate the unwanted effects that these items can create, provided the pilot always ensures they are stowed in these pockets when not in use. If your aircraft is frequently used for carriage of passengers taking aerial photographs, we suggest that you prohibit the stowage of articles within 24 inches of the compass.

AIRCRAFT RADIO

It was by chance that the crew of a passenger aircraft found that a small portable radio being used by a passenger seated in the forward part of the cabin was interfering with the aircraft's VHF navigation system. Further investigation disclosed that this particular portable receiver was actually a very effective transmitter. Fortunately, this type of interference is rare, but it could have serious results during the more critical flight phases such as instrument descents.

The electronic equipment of an aircraft is designed and carefully checked to ensure that it does not radiate interference and that its susceptibility to interference is as low as possible. Domestic and portable radios are not required to meet such stringent design criteria, and are capable of creating interferences in certain units of airborne radio equipment.

We have already drawn to the attention of airline operators the possibility of interference being created in this manner, and suggested that they make it mandatory for cabin attendants to require any passenger using a portable radio to turn the set off before an aircraft enters a descent phase where radio aids may be used to a fine tolerance. The possibility of interference occurring in this manner should also be borne in mind in any aircraft where radio aids are used for navigational purposes.

The pilot-in-command has authority under the Air Navigation Regulations to require a passenger to switch off or cease using any equipment if he believes it might create undesirable effects. The interference potential of a receiver in use by a passenger can generally be assessed by operating the set through its full range of frequencies in close proximity to the various items of aircraft radio equipment.

MYSTERY SPINS IN A GLIDER

A pilot, who had been trained on powered aircraft by the R.A.A.F. during the war years, turned his interest to gliding in 1958 and by October of last year he had experienced 133 glider launches involving almost 14 hours of flight time. The club to which he belonged had a flying day on 17th October, 1959, and during the morning he was winch-launched in a Kingfisher glider, remaining aloft in thermals close to the airfield for about 12 minutes. Six minutes after landing from the first flight he was launched again in the Kingfisher and was seen circling for some time at a height of about 1,000 feet, three-quarters of a mile downwind from the airfield.

Some fifteen minutes after the second launching, observers on the ground saw the glider come out of a medium turn to the right and hold a heading towards the airfield for a few seconds. Then, without warning, the nose dropped and the glider spun to the right for about three turns and recovered to level flight at a height of about 400 feet. Although the glider was then laterally level it appeared, even from the ground, to be unsteady in the pitching plane and within ten seconds it spun again to the right and struck the ground in an almost vertical attitude and overturned. The pilot died shortly after the accident from injuries received in the impact.

The circumstances in which these two spins occurred and the observed behaviour of the aircraft suggested at the outset that they had not been voluntarily undertaken by the pilot. Considerable care was therefore taken in assessing the airworthiness of the aircraft. It had been properly inspected by a qualified club officer prior to flight on this day and a thorough post-accident examination of the glider failed to reveal evidence of any defect which existed prior to the accident or of any other condition which might have contributed to it.

The possibility of the pilot experiencing some physiological disability whilst in the air was also explored and, although obviously no firm conclusion on this point could be reached, there is no evidence that this pilot would be any more liable to sudden collapse than most other pilots currently flying.

Although these spins occurred in the approach area to the landing field and at a lower height than could be considered safe the evidence of club instructors and members all indicated that the pilot was normally careful and conscientious in respect of the gliding rules. He was also regarded as being quite proficient and in current practice in respect of spin manoeuvres in the Kingfisher. It is difficult to believe that a careful pilot would have voluntarily initiated these spins in such circumstances or that a proficient pilot would have failed to regain and retain control of the glider in the airspace available. There is also the fact that in the brief period of level flight between the first and the final spin the observed behaviour of the glider was such that it appeared to be not under positive control.

It has not been possible in the face of this conflicting evidence to determine what was the cause of this accident, but the preponderance of evidence points to the possibility that something occurred to either the pilot or to the aircraft which induced a loss of control from which recovery could not be effected. The details of this accident are published not with the aim of making any particular safety point, but with the hope that some obscure but useful purpose may be served. If the mental exercise involved in pondering the possible causes of this accident leads a glider pilot to a careful analysis of his own flying habits the efforts will not have been wasted.

RUPTURED FUEL HOSE

The fuel flow on one engine of a military aircraft increased during cruise at 32,000 feet until it reached 2,500 pounds above the other engines. All other engine instruments were normal. Before a landing could be made the engine burst into flames which engulfed the entire pod. The engine was shut down and a successful landing was made.

Investigation revealed that the fuel hose assembly had ruptured, allowing raw fuel to enter the forward compressor section.

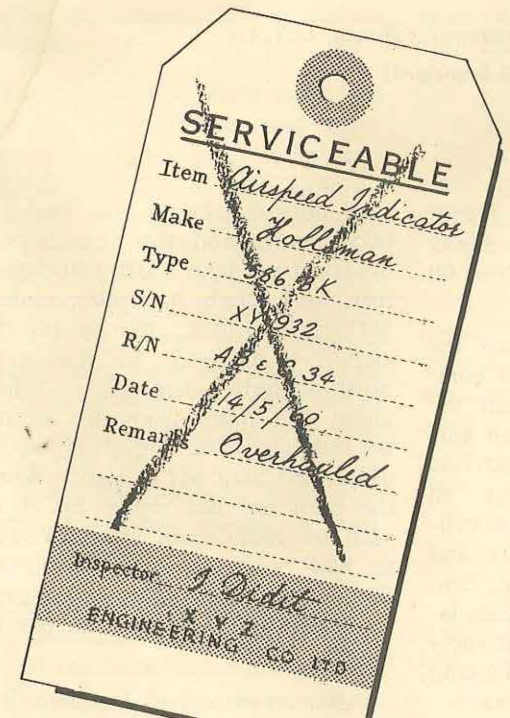
Mechanics are reminded that particular attention must be given to the proper alignment of high pressure fuel hoses. They are very susceptible to failure when twisted during installation.

Aviation Mechanics Bulletin.

SERVICEABILITY TAGS

Recently, two rotatable assemblies were dropped. They had been damaged and were considered unserviceable, so were routed back to the shop for check and repair.

However, the parts nearly got back into Stores as serviceable because the Serviceable Parts Tags were left on them.



Best "pull" the tag whenever the condition of a unit becomes questionable, so there cannot be even a remote possibility of it being used on aircraft.

Weekly Maintenance Letter.

Fuel Fumbling

(Extract from Aviation Mechanics' Bulletin, September-October, 1959)

The complete exclusion of gasoline from areas where it is never supposed to be demands constant vigilance. The following quote from a Captain's Debrief Report reveals how an oversight in preparing material for shipment can create a deadly threat to safety in flight.

"When about 40 minutes out of xxx we had a very strong odour of gasoline in the cockpit. Checked several things and took all possible precautions while looking and analysing. We finally found a box of company material to be the source of the gasoline odour. It was on the floor of a baggage bin in our area.

"It was a shipment of two fuel injection pump units to the overhaul base.

"One of these units had been put into its box with considerable gasoline in it. There were red plastic caps on a few openings.

"What occurred was this: We changed altitude just prior to the appearance of the odour, causing the cabin to climb from sea level for the first time. This probably caused enough expansion to push the gasoline past a loose plastic cap, pouring it into the case and on to the floor of the baggine bin. This could have been more dangerous had we not found it early enough, for drippage could have reached the inverters below.

"I now realise why no word by radio is heard from a flight experiencing strong gasoline odours on the flight deck. I was simply afraid to move an electrical switch or press a mike button until we found out where and what was the source of the gasoline fumes.

"Obviously, I would like to feel that appropriate action is taken to ensure that these fuel pump units are free of all fuel before being put aboard an aircraft for shipment."

It just isn't safe to ship gasoline around this way and it isn't legal, either.

Maintenance people must shoulder the responsibility of making sure all fuel system accessories are acceptable for shipment by company plane before the parts are released from the possession of Maintenance.

INSTRUMENT CONDITIONS TRAP BONANZA

IOWA, U.S.A.

A Beech Bonanza crashed at night approximately five miles north-west of the Mason City Municipal Airport, Mason City, Iowa, at approximately 0300 hours on 3rd February, 1959. The pilot and three passengers were killed and the aircraft was demolished.

(Summary based on the Report of the Civil Aeronautics Board, U.S.A.)

(All times herein are U.S.A. Central Standard)

The aircraft was observed to take-off towards the south in a normal manner, turn and climb to an estimated altitude of 100 feet, and then head in a north-westerly direction. When approximately five miles had been traversed, the tail light of the aircraft was seen to descent gradually until it disappeared from sight. Following this, many unsuccessful attempts were made to contact the aircraft by radio. The wreckage was found in a field later that morning.

This accident, like so many before it, was caused by the pilot's decision to undertake a flight in which the likelihood of encountering instrument conditions existed, in the mistaken belief that he could cope with en route instrument weather conditions without having the necessary familiarisation with the instruments in the aircraft and without being properly certified to fly solely by instruments.

INVESTIGATION

A group of entertainers appearing in Clear Lake, Iowa, decided to charter an aircraft to fly to Fargo, North Dakota, the nearest airport for Moorhead, Minnesota, where they were scheduled to appear on the following evening.

At approximately 1730 hours, the pilot went to the air traffic communications station to obtain the necessary weather information pertinent to the flight. He was advised by the communicator that all stations en route were reporting ceilings of 5,000 feet or better and visibilities of 10 miles or above; also that the Fargo terminal forecast indicated the possibility of light snow showers after 0200 hours and a cold frontal passage about 0400 hours.

At 0040 hours, after preparation had been completed for the flight, the pilot taxied the aircraft to the end of Runway 17 then called A.T.C.S. requesting latest local and en route weather. This was given him as not having changed materially en route; however, the local weather was reported as: Precipitation ceiling 3,000 feet, sky obscured, visibility six miles, light snow with winds south 20 knots and gusts to 30 knots, altimeter setting 29.83 inches.

A normal take-off was made at 0055 hours and the aircraft was observed to make a left 180 degree turn and climb to approximately 800 feet and then, after passing the airport to the east, to head in a north-westerly direction. When about five miles from the airport the tail light of the aircraft gradually descended until out of sight. When the pilot did not report his flight plan by radio soon after take-off, as had been previously arranged, the communicator repeatedly tried to reach him but was unable to do so.

After an extensive air search, the wreckage of the aircraft was sighted in an open field at approximately 0935 hours that morning. All occupants were dead and the aircraft was demolished. The field in which the aircraft was found was level and covered with about four inches of snow.

The accident occurred in a sparsely inhabited area and there were no witnesses. Examination of the wreckage indicated that the first impact with the ground was made by the right wing tip when the aircraft was in a steep right bank and in a nose-low attitude. It was further determined that the aircraft was travelling at high speed on a heading of 315 degrees. Parts were scattered over a distance of 540 feet, at the end of which the main wreckage was found lying against a barbed wire fence.

Although the aircraft was badly damaged, certain important facts were determined. There was no fire. All components were accounted for at the wreckage site. There was no evidence of in-flight structural failure or failure of the controls. The landing gear was retracted at the time of impact. The damaged engine was dismantled and examined; there was no evidence of engine malfunctioning or failure in-flight.

The pilot was regularly employed as a commercial pilot and flight instructor. He had been flying since October, 1954, and had accumulated 711 hours, of which 128 were in Bonanza aircraft. Almost all of the Bonanza time was acquired during charter flights. When his instrument training was taken, several aircraft were used and these were all equipped with the conventional type artificial horizon and none with the Sperry Attitude Gyro such as installed in the Bonanza. These two instruments differ greatly in their pictorial display.

The conventional artificial horizon provides a direct reading indication of the bank and pitch attitude of the aircraft, which is accurately indicated by a miniature aircraft pictorially displayed against a horizon bar and as if observed from the rear. The Sperry F3 gyro also provides a direct reading indication of the bank and pitch attitude of the aircraft, but its pictorial presentation is achieved by using a stabiliser sphere whose free-floating movements behind a miniature aircraft presents pitch information with a sensing exactly opposite from that depicted by the conventional artificial horizon.

THE WEATHER

The surface weather chart for 0000 on February 3, 1959, showed a cold front extending from the north-western corner of Minnesota through central Nebraska with a secondary cold front through North Dakota. Widespread snow shower activity was indicated in advance of these fronts. Temperatures along the airway aroute from Mason City to Fargo were below freezing at all levels with an inversion between 3,000 and 4,000 feet and abundant moisture content was such that moderate to heavy icing and precipitation existed in the clouds along the route. Winds aloft along the route at altitudes below 10,000 feet were reported to be 30 to 50 knots from a south-westerley direction, with the strongest winds indicated to be closest to the cold front.

A flash advisory issued by the U.S. Weather Bureau at Minneapolis at 2335 hours on February 2 contained the following information: "Flash Advisory No. 5. A band of snow about 100 miles wide at 2335 from extreme north-western Minnesota, northern North Dakota through Bismarck and south-southwestward through Black Hills of South Dakota with visibility generally below two miles in snow. This area or band moving south-eastward about 25 knots. Cold front at 2335 from vicinity Winnipeg through Minot, Williston, moving southeastward 25 to 30 knots with surface winds following front north-north-west 25 gusts 45. Valid until 0335." Another advisory issued by the U.S. Weather Bureau at Kansas City, Missouri, at 0015 on February 3, was: "Flash Advisory No. 1. Over eastern half Kansas ceilings are locally below one thousand feet, visibilities locally two miles or less in freezing drizzle, light snow and fog. Moderate to locally heavy icing areas of freezing drizzle and locally moderate icing in clouds below 10,000 feet over eastern portion Nebraska, Kansas, north-west Missouri, and most of Iowa. Valid until 0515." Neither communicator could recall having drawn these flash advisories to the attention of the pilot. The operator said that when he accompanied the pilot to A.T.C.S. no information was given them indicating instrument flying weather would be encountered along the route.

ANALYSIS

There is no evidence to indicate that very important flash advisories regarding adverse weather conditions were drawn to the attention of the pilot. On the contrary, there is evidence that the weather briefing consisted solely of the reading of current weather at en route terminals and terminal forecasts for the destination. Failure of the communicators to draw these advisories to the attention of the pilot and to emphasise their importance could readily lead the pilot to underestimate the severity of the weather situation.

At Mason City, at the time of take-off, the barometer was falling, the ceiling and visibility were lowering, light snow had begun to fall, and the surface winds and winds aloft were so high one could reasonably have expected to encounter adverse weather during the estimated two-hour flight.

It was already snowing at Minneapolis, and the general forecast for the area along the intended route indicated deteriorating weather conditions. Considering all of these facts and the fact that the company was certified to fly in accordance with visual flight rules only, both day and night, together with the pilot's unproven ability to fly by instruments, the decision to go seems most imprudent.

It is believed that shortly after take-off the pilot entered an area of complete darkness and one in which there was no definite horizon; that the snow conditions and the lack of horizon required him to rely solely on flight instruments for aircraft attitude and orientation.

The high gusty winds and the attendant turbulence which existed this night would have caused the rate of climb indicator and the turn and bank indicator to fluctuate to such an extent that an interpretation of these instruments, so far as attitude control is concerned, would have been difficult to a pilot of his experience. The airspeed and altimeter alone would not have provided him with sufficient reference to maintain control of the pitch attitude. With his limited experience the pilot would tend to rely on the attitude gyro which is relatively stable under these conditions.

Service experience with the use of the attitude gyro has clearly indicated confusion among pilots during the transition period or when alternating between conventional and attitude gyros. Since he had received his instrument training in aircraft equipped with the conventional type artificial horizon, and since this instrument and the attitude gyro are opposite in their pictorial display of the pitch attitude, it is probable that the reverse sensing would, at times, produce reverse control action. This is especially true of instrument flight conditions requiring a high degree of concentration or requiring multiple function, as would be the case when flying instrument conditions in turbulence without a co-pilot. The directional gyro was found caged and it is possible that it was never used during the short flight. However, this evidence is not conclusive. If the directional gyro was caged throughout the flight this could only have added to the pilot's confusion.

CONCLUSION

At night, with an overcast sky, snow falling, no definite horizon, and a proposed flight over a sparsely settled area with an absence of ground lights, a requirement for control of the aircraft solely by reference to flight instruments can be predicted with virtual certainty.

The Board concludes that the pilot, when a short distance from the airport, was confronted with this situation. Because of fluctuation of the rate instruments caused by gusty winds, he would have been forced to concentrate and rely greatly on the attitude gyro, an instrument with which he was not completely familiar. The pitch display of this instrument is the reverse of the instrument he was accustomed to; therefore, he could have become confused and thought that he was making a climbing turn when, in reality, he was making a descending turn. The fact that the aircraft struck the ground in a steep turn but with the nose lowered only slightly, indicates that some control was being effected at the time. The weather briefing supplied to the pilot was seriously inadequate in that it failed to even mention flying conditions which should have been highlighted.

PROBABLE CAUSE

The Board determines that the probable cause of this accident was the pilot's unwise decision to embark on a flight which would necessitate flying solely by instruments when he was not properly certified or qualified to do so. Contributing factors were serious deficiencies in the weather briefing, and the pilot's unfamiliarity with the instrument which determines the attitude of the aircraft.

OLD REMEDY WORKS

Occasionally in these pages we have mentioned the insidious practice of quick and easy type fixes to postpone more thorough and exacting fault isolation and correction procedures.

One of the old stock answers was, "Cleaned and tightened electrical connector."

Now here's one for the books. Shortly after acceptance, a turbo-prop aircraft started having high engine oil temperature squawks. Corrective action in this case seemed quite "thorough and exacting." Out of 39 flight crew reports:

12 oil temperature thermostats were replaced.

2 inducer valves were replaced.

2 oil cooler door actuators were replaced.

2 oil cooler door actuators were re-rigged.

1 oil temperature sensing bulb was replaced.

Then, finally, after 481 hours somebody "cleaned and tightened the electrical plug" to the indicator, and **that** fixed the squawk.

—*Aviation Mechanics' Bulletin.*

DH.82 STALLS DURING FORCED LANDING

In carrying out a forced landing following complete power failure in a DH.82, the pilot allowed the aircraft to stall in a turn at 100 ft. and the aircraft struck the ground in a steep nosedown attitude. The pilot was seriously injured and the aircraft extensively damaged, but the passenger escaped with only minor injuries.

A private owner-pilot undertook a series of short local flights in his DH.82 at a country aerodrome in South Australia last year. In the middle of the afternoon he was returning towards the aerodrome at a height of 800 feet with a passenger aboard when they noticed a bird at the same height. A tight turn around the bird was carried out before the course was once again resumed. Very soon after this diversion the engine coughed, spluttered and then cut out completely. The pilot could see that the glide would not "stretch" to the aerodrome so he decided to make an emergency landing in a cleared, flat field immediately below. He entered what was intended to be a 300-degree left turn, but after turning through some 180 degrees the aircraft stalled at about 100 feet.

It was quickly established that the engine stopped because of fuel starvation, but there was still two gallons of fuel left in the tank and no satisfactory explanation was reached as to why it could not be utilised. Nevertheless, the investigation did reveal some safety considerations which are not new but which are worth repeating.

An examination of the fuel tank led to the recovery of 20 pieces of rubber hose-lining of assorted sizes up to two inches by one inch together with a loose bolt. Quite obviously this indicates a lack of care, particularly in filtering during refuelling. Because there are 21 outlet holes of ⅛" diameter from the tank to the sump in this aircraft it is difficult to believe, however, that these foreign bodies alone would completely cut off the fuel supply and tests have confirmed this view.

The fact that only two gallons of fuel were found in the tank after a 15 minute flight indicates quite clearly that the flight was commenced with less than the minimum required, including reserves. The Light Aircraft Handbook at Section RAC/3-1, paragraph 1.2, specified a minimum reserve of 45 minutes which, as applied to this flight, required a minimum of six gallons at take-off. Two gallons of fuel spread over the nearly flat bottom of a DH.82 tank provides very little coverage of the outlet even in level flight. It is quite probable that in sharp manoeuvres, such as the turns around the bird, the outlet would be uncovered and the fuel supply temporarily interrupted. Here again, however, it is difficult to believe that this would lead to a permanent cessation of fuel flow in a gravity feed system.

It is worth mentioning that the pilot of this aircraft was thrown forward on to the crash pad and instrument panel receiving severe facial injuries whilst the passenger suffered only slight concussion. Both wore "Q" type harnesses, but that of the pilot was only loosely fastened allowing considerable movement of his body whilst the passenger's harness was fastened firmly thus affording the necessary restriction to prevent serious injury. THIS LESSON IS NOT ONLY OLD, IT IS OBVIOUS — BUT ALL TOO FREQUENTLY IGNORED.

In the forced landing the pilot elected to turn through 300 degrees left to approach into wind on a cleared area half a mile long. This involved turning his back on the selected field and thus allowed little opportunity to compensate for miscalculations or variations in the descent rate or the effects of drift. It also ignored the fundamental principle of forced landing techniques to make all turns towards the selected field so as to keep it in sight. There was nothing wrong with the pilot's decision to land in this field, but his faulty planning of the forced landing approach path presented him with unnecessary difficulties, to say the least, and was undoubtedly the prime circumstance which led to the inadvertent stall.

Pointing A Loaded Weapon

Awaiting start-up at a non-capital city airport the captain of a modern turbo-prop airliner observed a light aircraft parked some 40 feet away facing directly towards the airliner. From his seat in the cockpit the captain watched the pilot, accompanied by a lady friend, prepare for departure in the light aircraft. After seeing the lady comfortably seated, the pilot removed the wheel chocks and proceeded to start his engine by swinging the propeller.

The airline captain, visualising the possibility of expensive repairs to his own aircraft, hastily asked the other pilot to either remove his aircraft to a safer position, or refrain from start-up until the airliner had departed. Realising the wisdom of this request, the pilot of the light aircraft delayed his start-up.

The accident potential in this situation was immediately evident to the safety conscious airline captain, but was apparently not recognised by the light aircraft pilot. By proceeding to start his aircraft with the chocks removed when it was aimed directly at an obstruction, he ignored two of the elementary precautions associated with engine starting and thereby displayed poor airmanship.

The existing rules require that when it is necessary to manipulate a propeller for starting purposes without a qualified person in the control seat, adequate provision is to be made to prevent the aircraft moving forward. Even though a qualified person may be in a control seat the majority of light aircraft operators insist that wheel chocks be used at all times when hand starting aircraft engines. Where this is practicable, it is sound common sense.

An uncontrolled and unrestrained aircraft is an almost certain accident. Even if an accident which could easily involve loss of life is averted, there are few occurrences more embarrassing than being the pilot-in-command of an aircraft which has moved off without you.

The HAIL OF IT

Messrs. Appleman and Lehr of Air Weather Services at Scott A.F.B. stated it at the recent Institute of the Aeronautical Sciences meeting:

"An aircraft sometimes encounters hail in clear air several miles from the nearest thunderstorm. In a study limited to 103 in-flight hail encounters, 20% of the hail encountered above 20,000 feet was found in clear air, beneath the anvil cloud or other overhanging clouds of the storm. Clear-air hail is also occasionally encountered between cumulonimbus towers, usually below 25,000 feet; apparently it is undetectable by the aircraft radar."

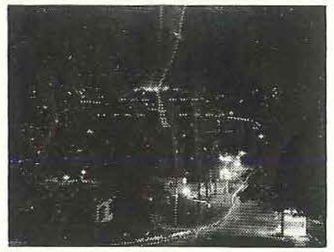
Flight Safety Foundation Bulletin.

MAINTENANCE CORNER

(Extract from Flight Safety Foundation Bulletin, March 15, 1960)

The failure of a mechanic to use a maintenance manual recently cost his company a pocket full of dollars, to wit: Two types of clutch selector valves are used on the same engine model. Each type of valve requires its own special gasket. These gaskets are not interchangeable, and all of this is spelled out in the company maintenance manual. Recently, two engines were prematurely removed for low oil pressure in high blower and attendant clutch slippage. In both cases the wrong type gasket was found beneath the selector valve. This error in gasket type cost 400 hours of lost engine operation, two sets of clutches, a repair bill amounting to approximately 500 dollars plus labour cost and the delay involved in changing the engine! All this because of failure to use the good information people have compiled for us.

Contents



Not the pilots' view of the High Intensity Approach Lighting, Melbourne Airport.
(Photograph by Wolfgang Sievers)

Prepared in the Division of Air Safety Investigation,
Department of Civil Aviation.